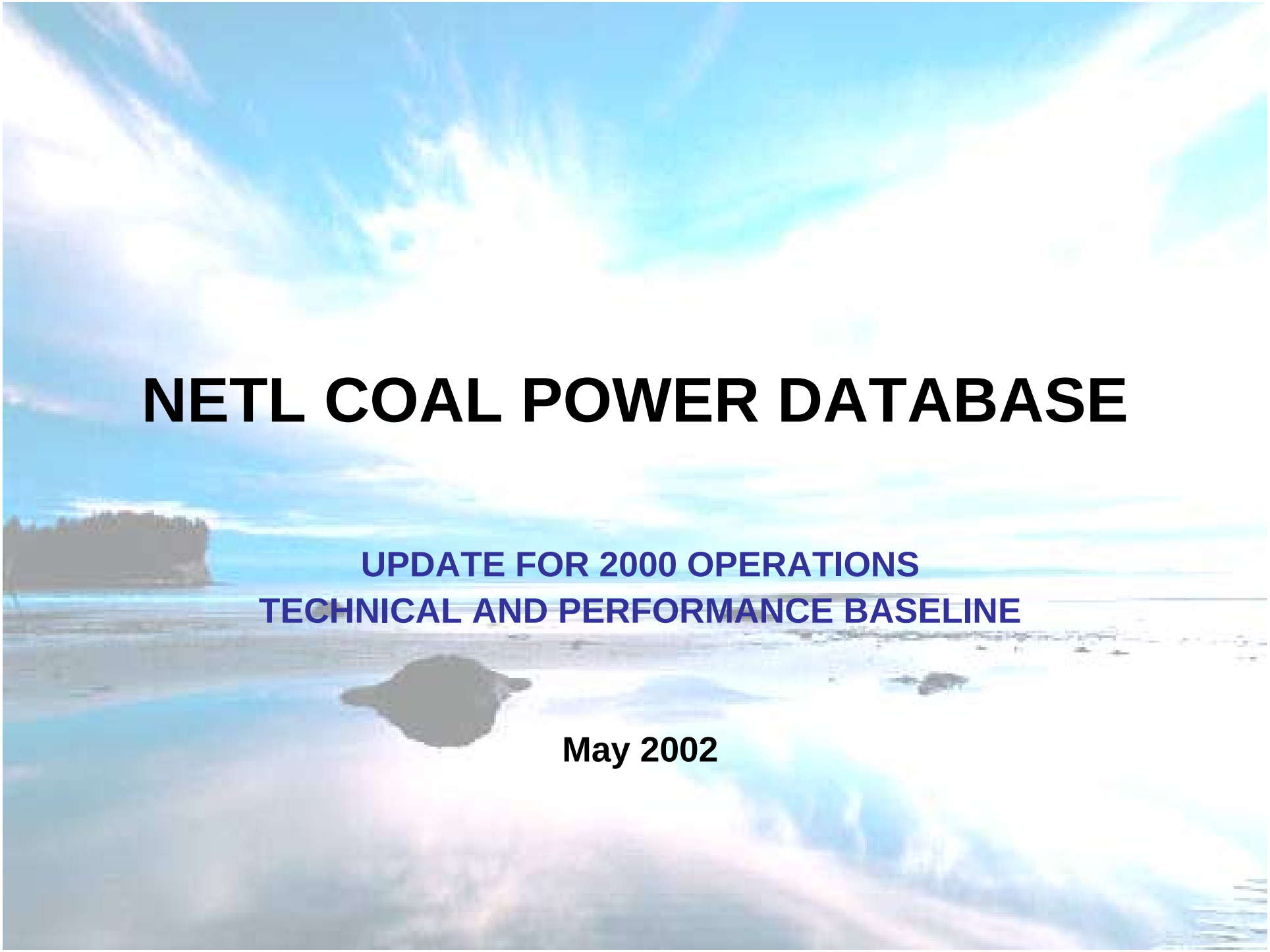


NETL COAL POWER DATABASE

UPDATE FOR 2000 OPERATIONS
TECHNICAL AND PERFORMANCE BASELINE

May 2002

DATABASE FEATURES

- **FUEL COMBUSTION UNIT OPERATIONS**
  - Covers All Utility Operations
  - 1160 UNITS
  - Pulverized Coal, Cyclone, Stoker, Fluidized Bed Combustion, IGCC
- **EMISSIONS**
  - SO_2, NO_x, Particulates, CO_2, and Mercury
- **POWER GENERATION AND PERFORMANCE**
  - Efficiency, Unit Generation, Capacity

BASELINE CONDITIONS

- **FUEL**
  - 962 Million Tons of Coal or 19.6 Quads
  - 19.8 Quads Total Fuel
- **POWER**
  - 1,925 Billion kWh or equivalently 6.6 Quads
- **EMISSIONS**
  - 2.1 Billion Tons of CO2
  - 10.8 Million tons of SO2
  - 4.6 Million Tons of NOx
  - 48.5 Tons of Mercury

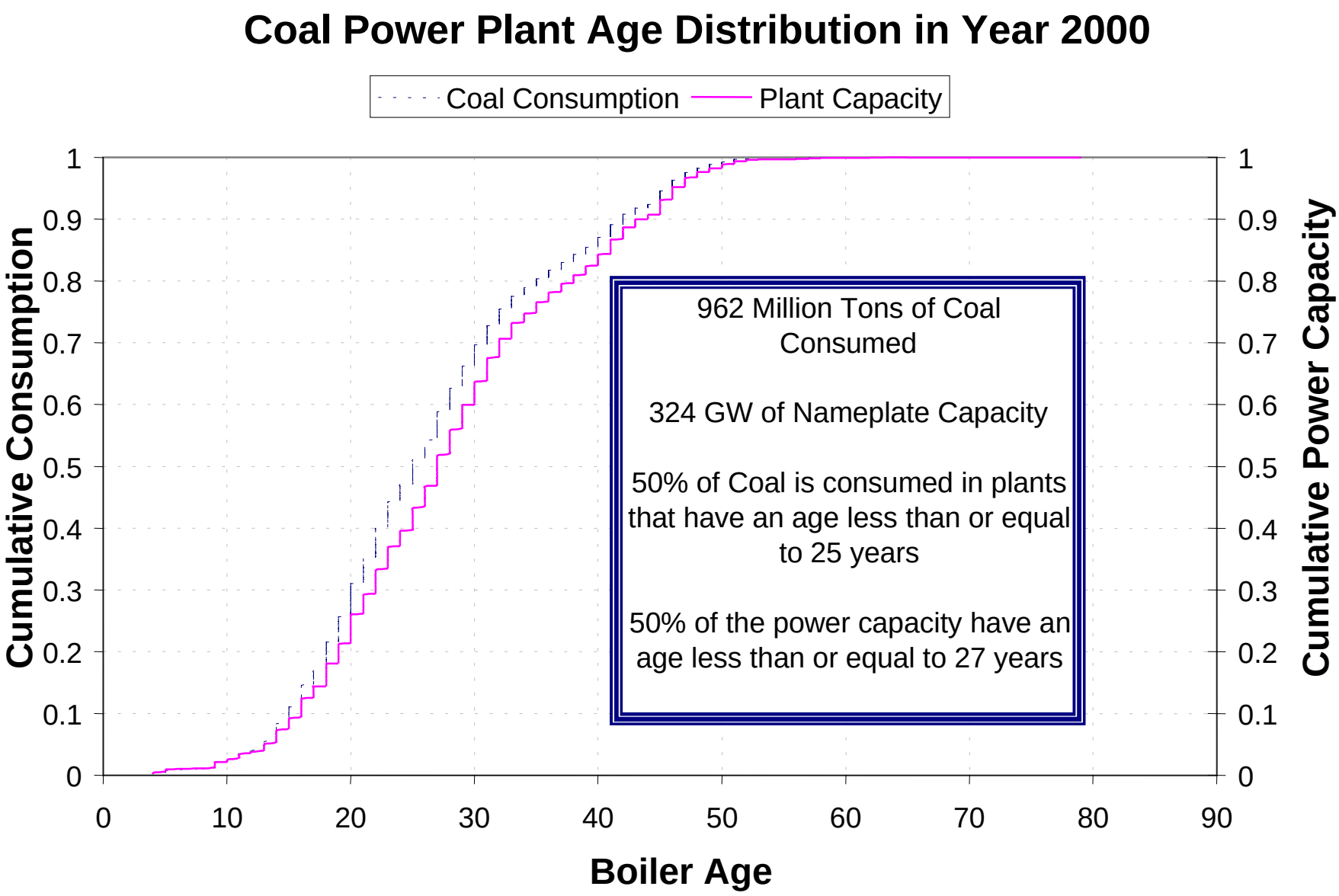
EMISSIONS CONTROL

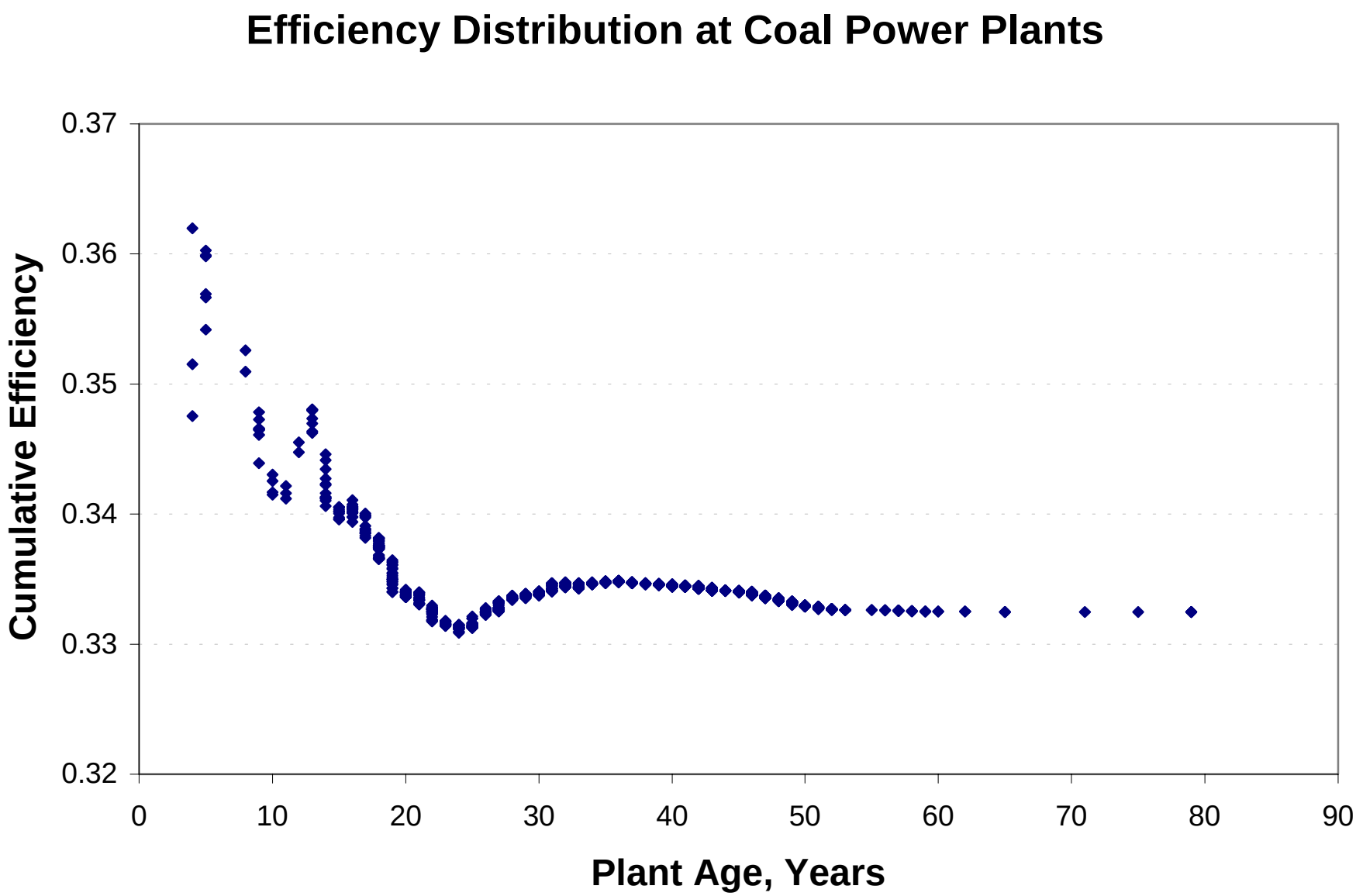
- **SO_2**
  - 8.1 Million Tons
  - 43% of Potential Emissions
- **NO_x**
  - 2.5 Million Tons
  - 35% of Potential Emissions
- **MERCURY**
  - 28.2 Tons
  - 37% of Potential Emissions

EXISTING PLANTS

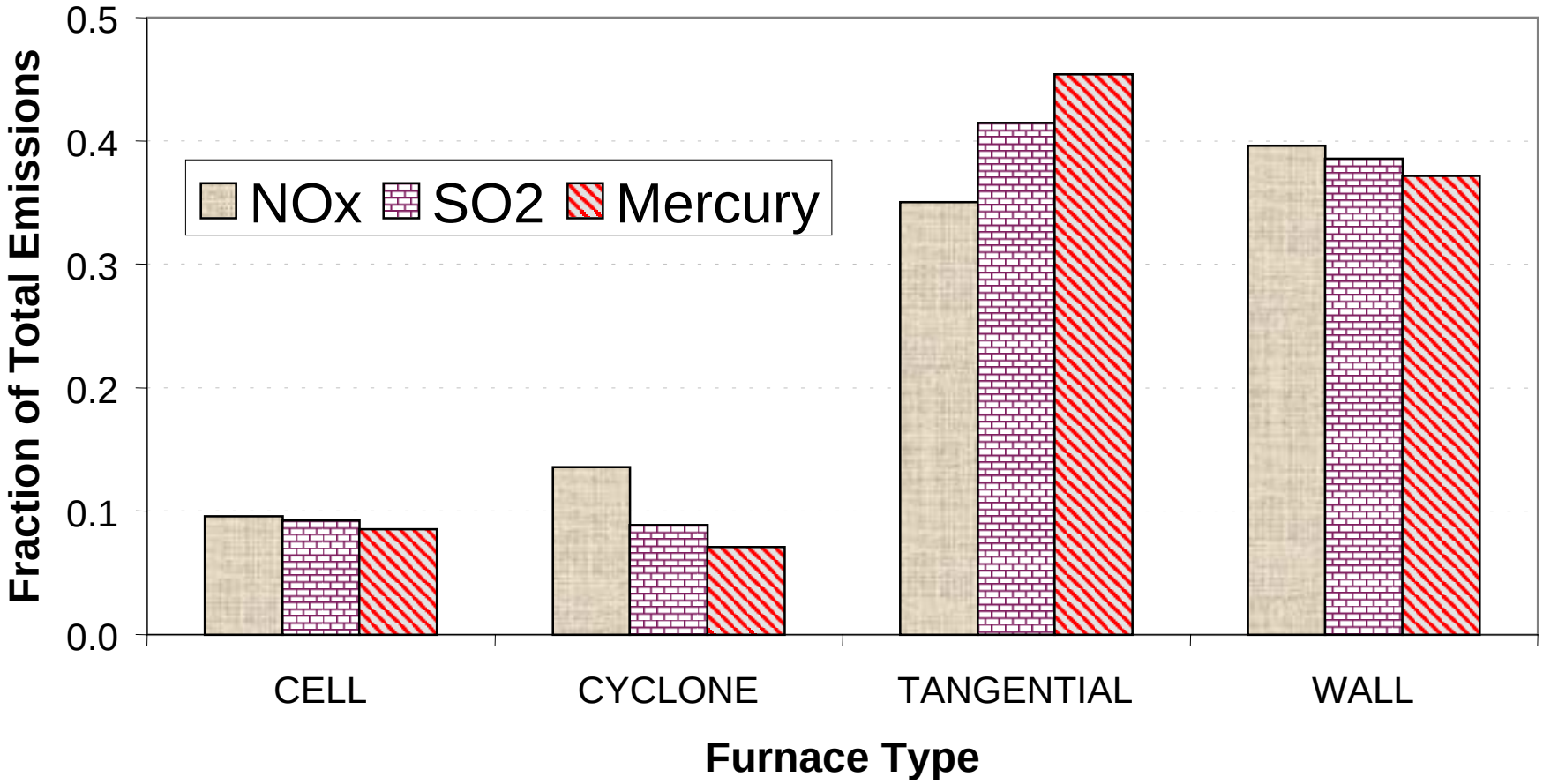
- **MAY NOT MEET NSPS**
  - Many of the plants are old and predate the Clean Air Act
  - Modernization or retirement ? expected lifespan exceeded in many cases

- **MUST BE READY TO IMPROVE**
  - Acid Rain Program
  - NOx SIP Call
  - Mercury Determination
  - New Source Review Trigger
  - Cooling Water Rulemaking
  - MultiPollutant Strategy


Coal Power Plant Age Distribution in Year 2000
Coal Consumption
Plant Capacity
Cumulative Consumption
Cumulative Power Capacity
Boiler Age
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
10
20
30
40
50
60
70
80
90
962 Million Tons of Coal Consumed
324 GW of Nameplate Capacity
50% of Coal is consumed in plants that have an age less than or equal to 25 years
50% of the power capacity have an age less than or equal to 27 years


Efficiency Distribution at Coal Power Plants
Cumulative Efficiency
0.37
0.36
0.35
0.34
0.33
0.32
0
10
20
30
40
50
60
70
80
90
Plant Age, Years

Emissions From Different Furnace Types (Represents 98% of Coal Power Capacity)



Average Emission Rates

	NOx, lb/MMBtu	SO2, lb/MMBtu	Hg, lb/TBtu
CELL	**0.60**	**1.35**	**5.66**
CYCLONE	**0.89**	**1.35**	**4.88**
TANGENTIAL	**0.37**	**1.04**	**5.11**
WALL	**0.46**	**1.05**	**4.57**

CONTROL EQUIPMENT

- **COMBUSTION**
  - Low NOx Burners
  - Other (Low Excess Air, Burners out of Service, Flue Gas Recirculation)
  - Fluidized Bed Combustion
- **POST COMBUSTION**
  - SCR, SNCR
  - Wet Scrubbers
  - Dry Scrubbers
  - ESP, Baghouses

Low NOx Burners (LNB)

- **INSTALLED ON DRY BOTTOM FURNACES**
  - Cell Burners
  - Wall Fired
  - Tangentially Fired
- **ADVANCED OVERFIRE AIR**
  - Wall Fired
  - Tangentially Fired

COMBUSTION CONTROLS

	NOx, lb/MMBtu	Capacity, GW
LOW NOx CELL BURNERS	0.56	19.2
LNB WALL FIRED	0.44	78.5
LNB OVERFIRE AIR WALL	0.42	27.8
LNB TANGENTIALLY FIRED	0.35	95.8
OTHER COMBUSTION CONTROL	0.51	29.3
UNCONTROLLED	0.64	44.4

NOx POST COMBUSTION

- **CONTROLS**
  - SCR
  - SNCR
- **STATUS IN 2000**
  - 22.6 GW of SCR Installed
  - SCR Full Performance **Not** Used
  - 5.1 GW of SNCR Installed

NOx POST COMBUSTION

	NOx, lb/MMBtu	Capacity, GW
LNB + SCR	0.48	8.9
LNB + SNCR	0.48	2.7
OTHER + SCR	0.77	9.2
OTHER + SNCR	0.66	1.0
SCR ONLY	0.97	4.5
SNCR ONLY	0.48	1.4

SO2 CONTROLS

- EMISSION RATE
  - Uncontrolled Rate is 1.38 lb/MMBtu
  - Controlled Rate is 0.46 lb/MMBtu
  - National Average Rate is 1.09 lb/MMBtu
- CONTROLS
  - 83.4 GW of Scrubbers
  - 7.4 GW of Spray Dryers
  - 2.3 GW of Other Flue Gas Controls
  - 1.6 GW of FBC and IGCC

SO2 CONTROLS

	SO2, lb/MMBtu	Capacity, GW
SCRUBBER	0.44	83.4
SPRAY DRYER	0.35	7.4
OTHER	1.60	2.3
UNCONTROLLED	1.38	229.5

PARTICULATE CONTROL

- **COMMON DEVICES**
  - Electrostatic Precipitator (ESP)
  - Baghouse
  - Mechanical Collector
  - Particulate Scrubber

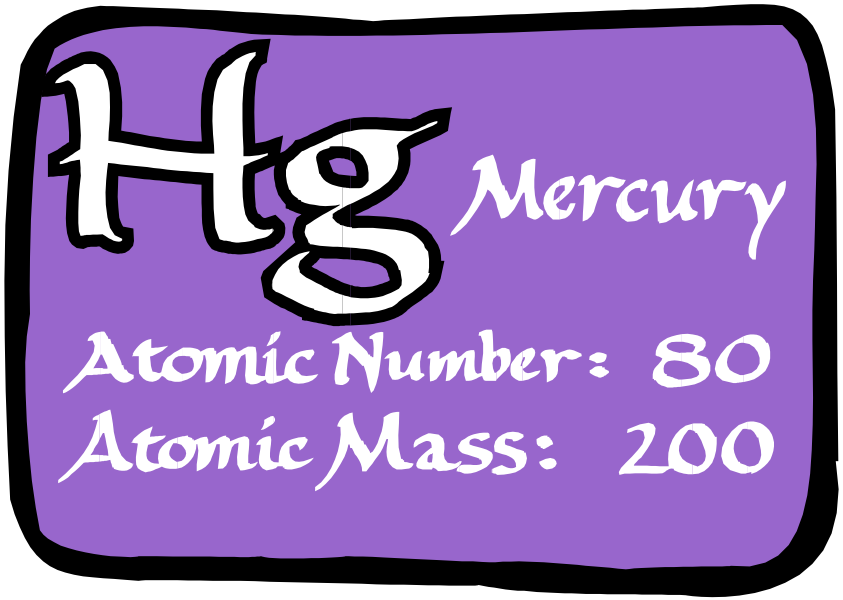
- **SPECIAL FEATURES**
  - Hot-Side or Cold-Side ESP
  - Flue Gas Conditioning (SO_3/NH_3 Addition) prior to ESP
  - Reverse Gas, Shaker, and Pulse Jet Baghouses

PARTICULATE CONTROL

	Capacity, GW
Cold-Side ESP	244.1
Hot-Side ESP	43.9
Baghouse	25.7
Particulate Scrubber	9.3
Mechanical Collector	0.7

MERCURY CONTROLS

- EXISTING EQUIPMENT
  - ESP, Baghouses
  - Scrubbers
  - Spray Dryers
  - SCR with Scrubbers



MERCURY REMOVAL

(ICR DATA – PARTICULATE CONTROL)

	BITUMINOUS	SUBBITUMINOUS	LIGNITE
COLD-SIDE ESP	36.9%	20.5%	0%
HOT-SIDE ESP	10.7%	0%	Not Measured
BAGHOUSE	82.3%	72.6%	Not Measured
PARTICULATE SCRUBBER	Not Measured	8.7%	Not Measured
MECHANICAL	0%	Not Measured	Not Measured

MERCURY REMOVAL

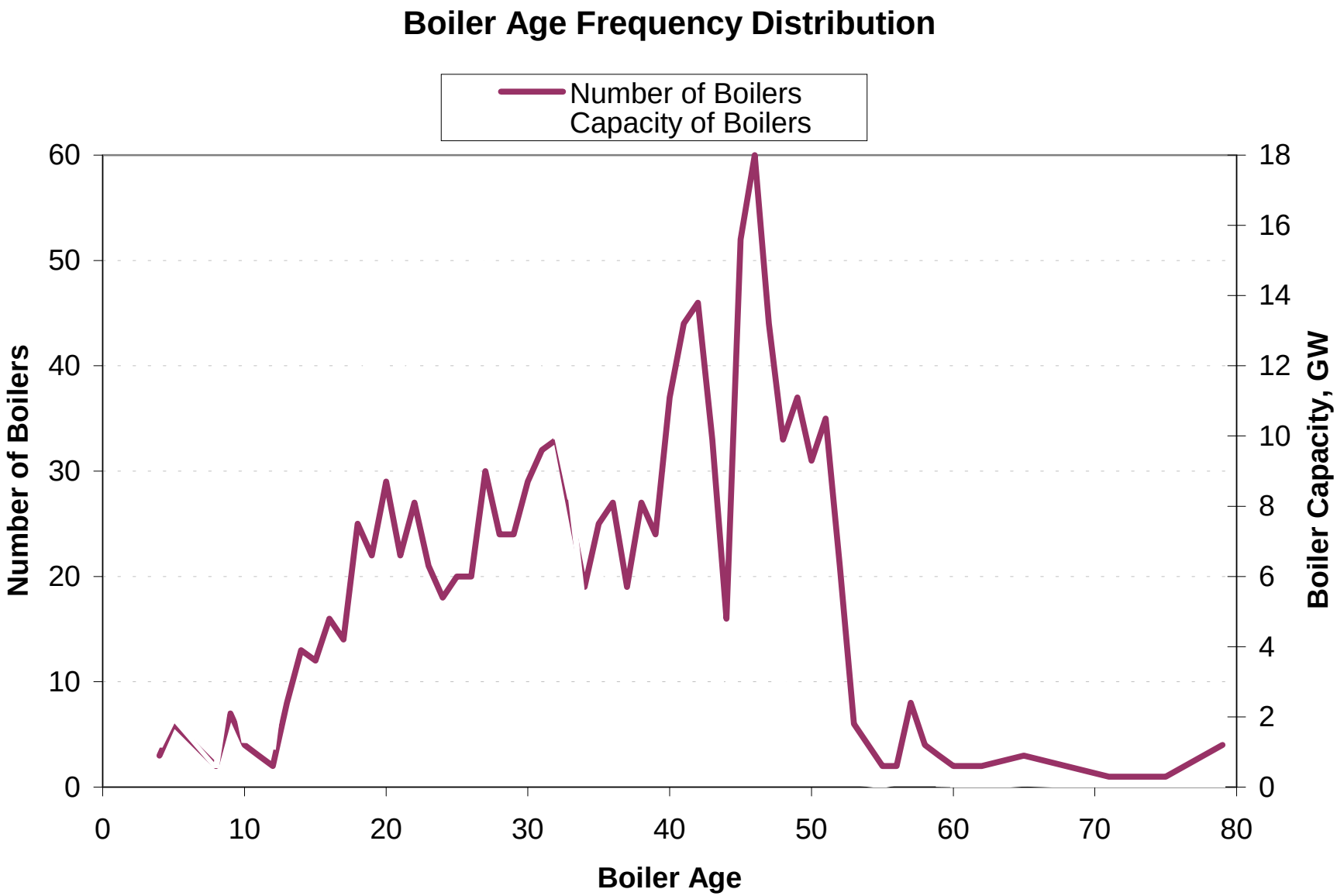
(ICR DATA – FGD CONTROL)

	BITUMINOUS	SUBBITUMINOUS	LIGNITE
SCRUBBER	49.3%	5.0%	40.1%
SPRAY DRYER WITH BAGHOUSE	96.2%	23.3%	24.3%

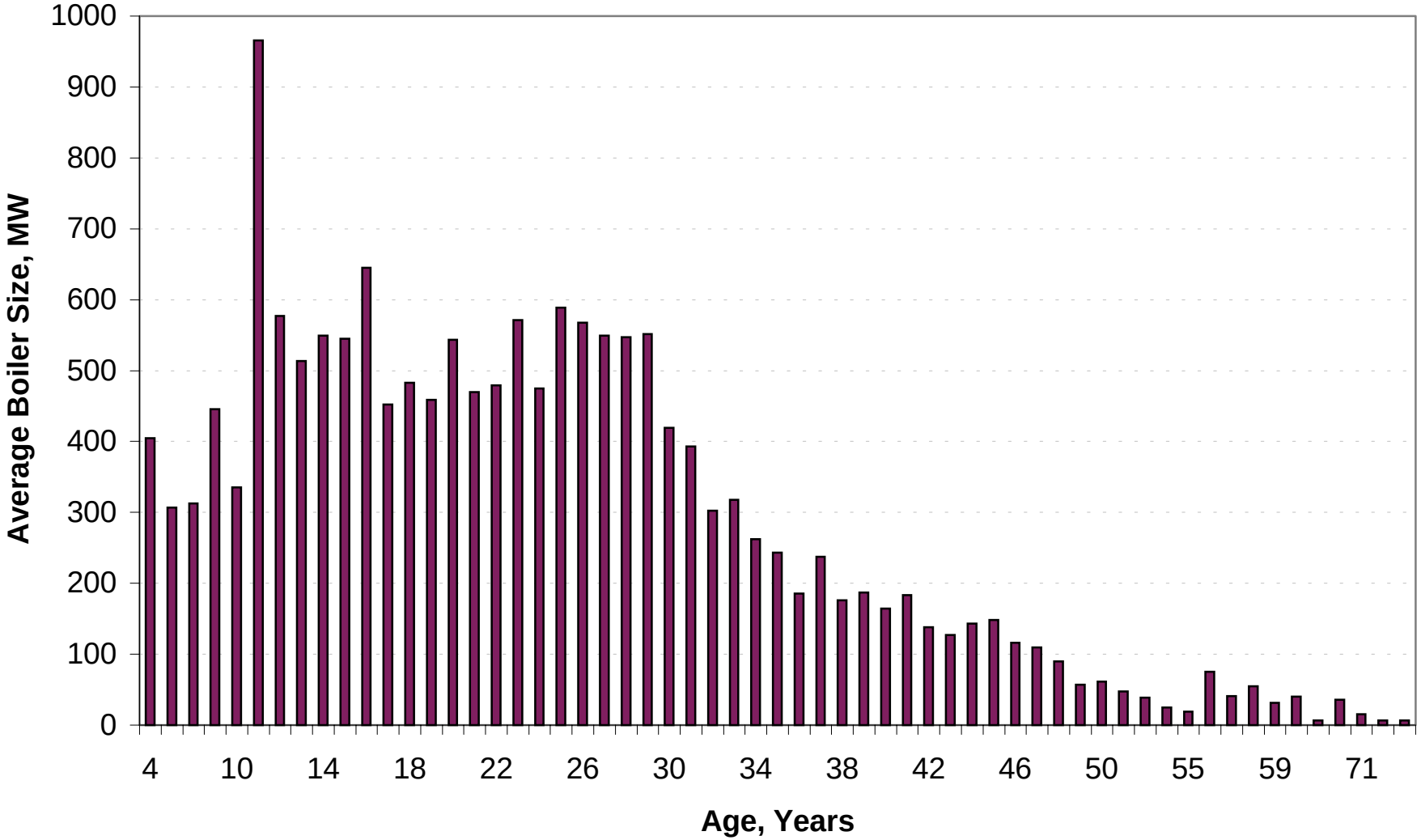
POWER PLANT AGING CHARACTERIZATION

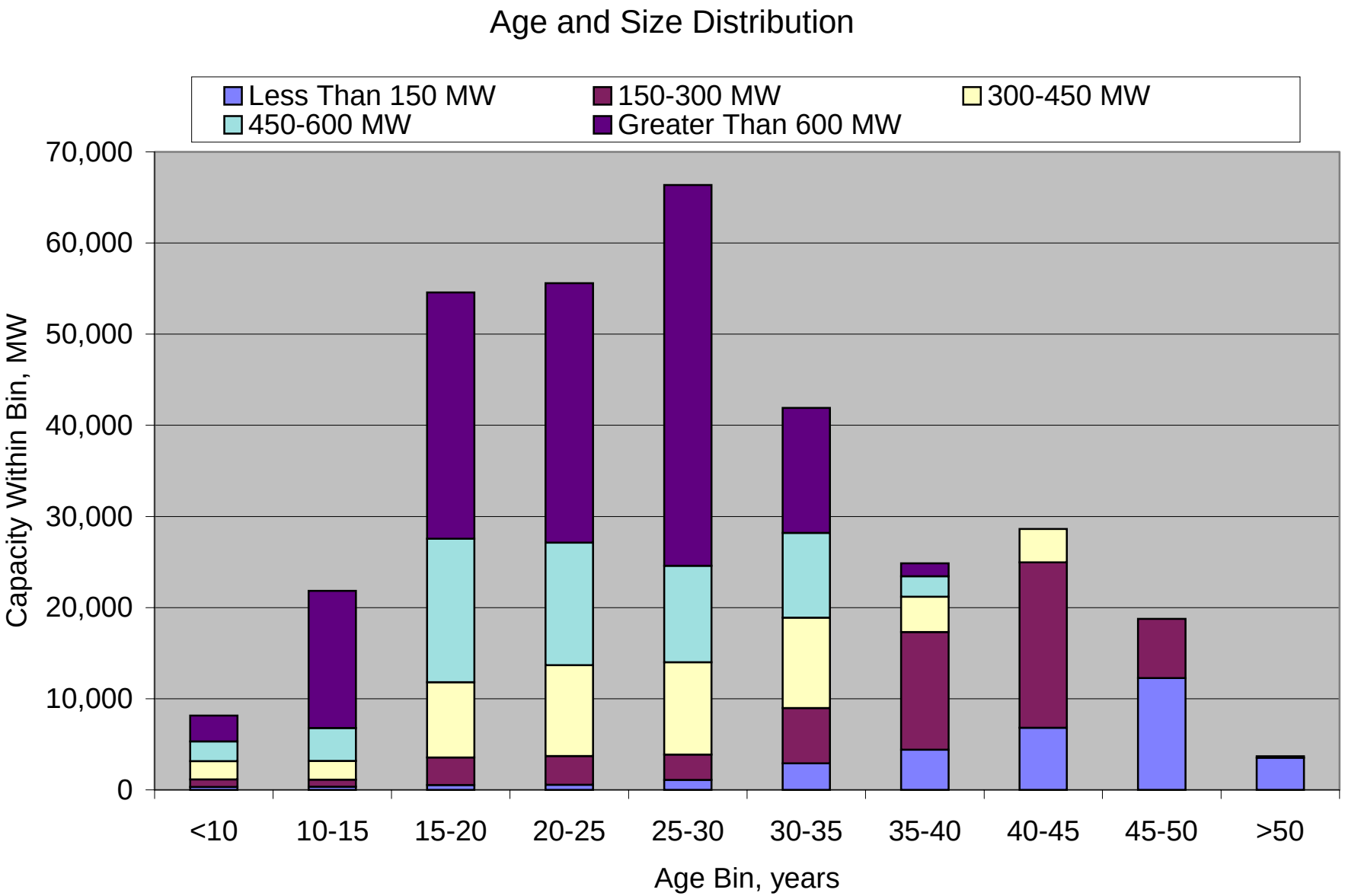
NETL Coal Power Database Analysis

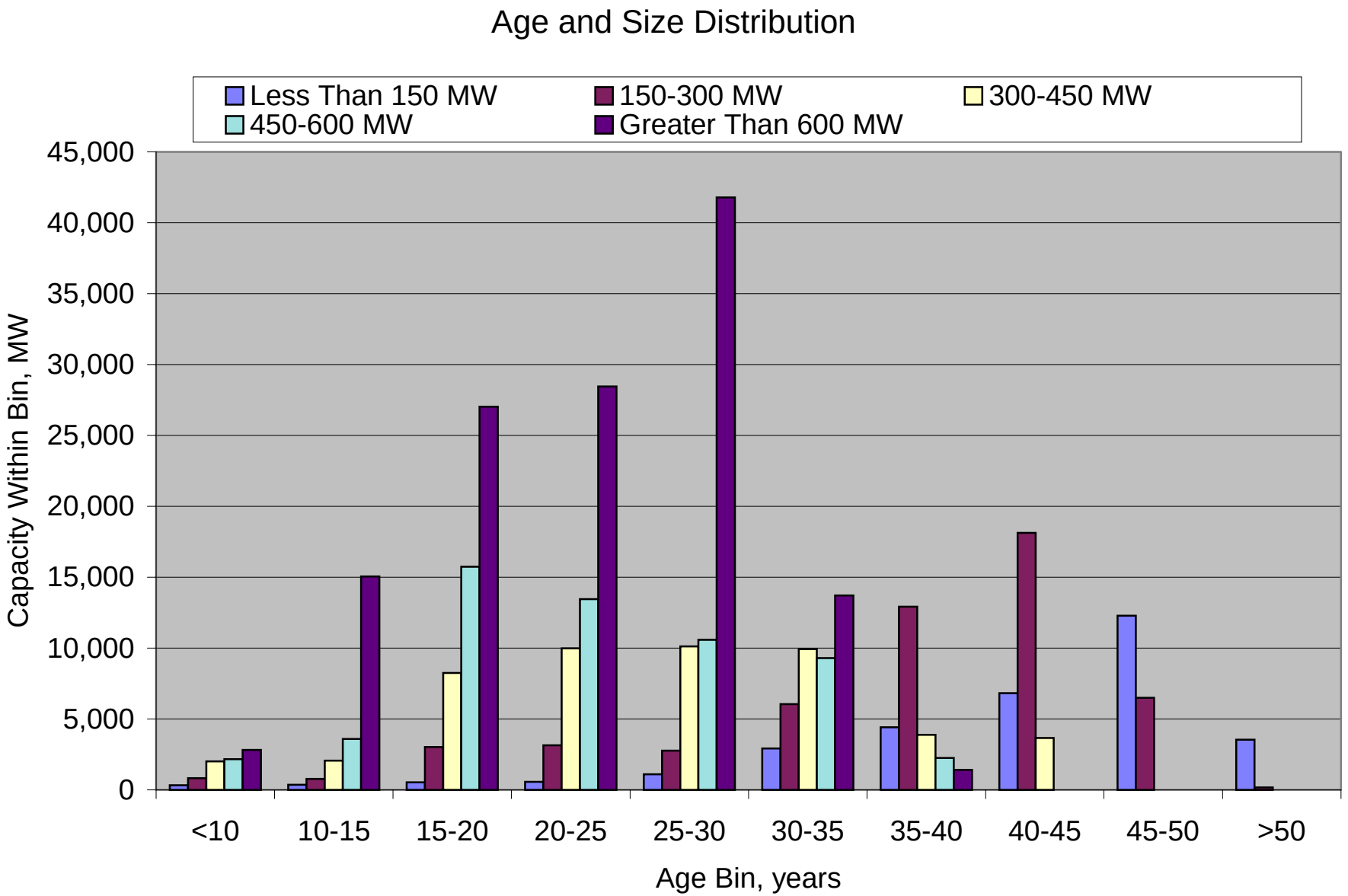
March 2002

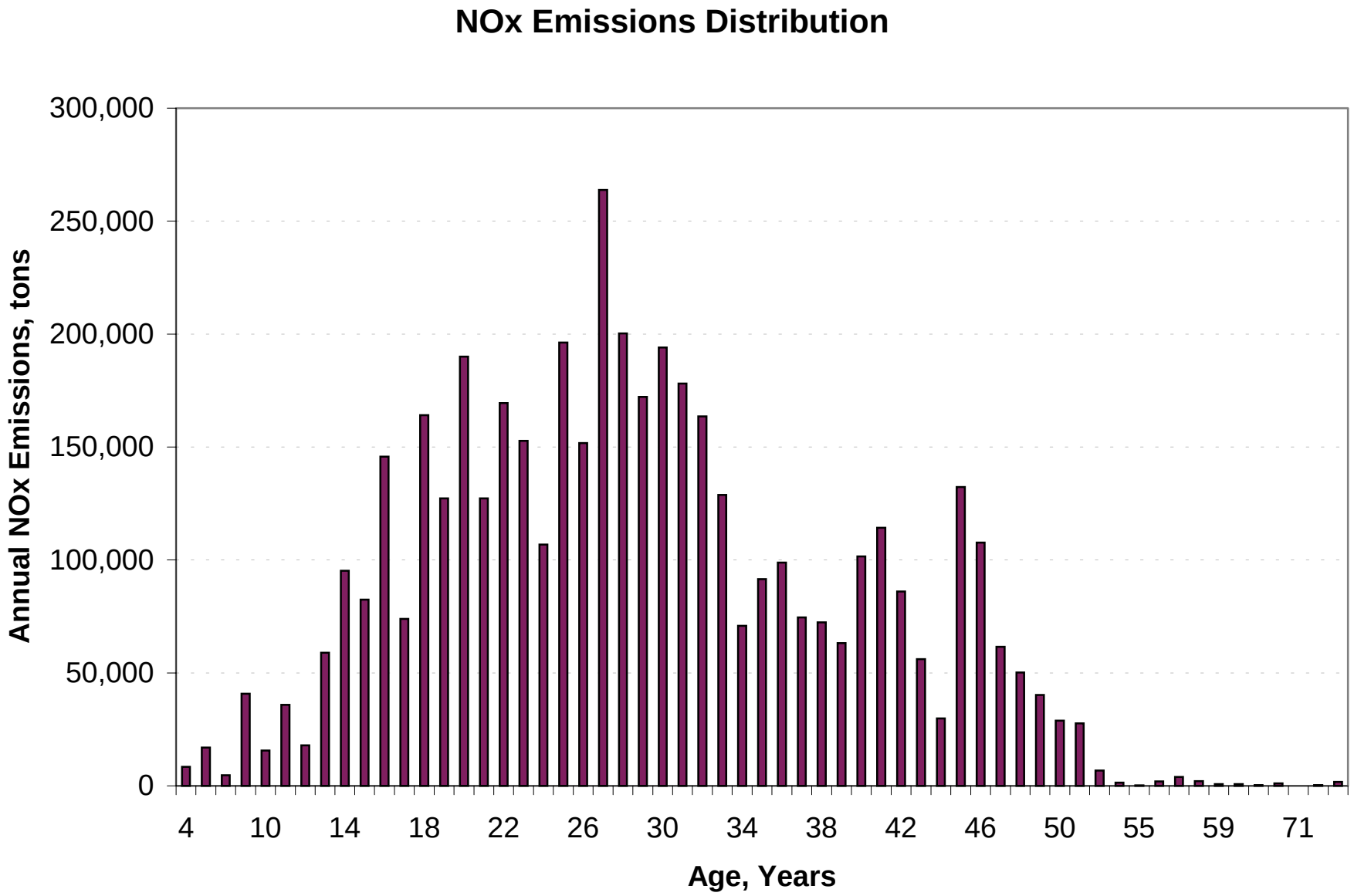

Boiler Age Frequency Distribution
Number of Boilers
Capacity of Boilers
Number of Boilers
Boiler Capacity, GW
Boiler Age
0
10
20
30
40
50
60
70
80
0
2
4
6
8
10
12
14
16
18

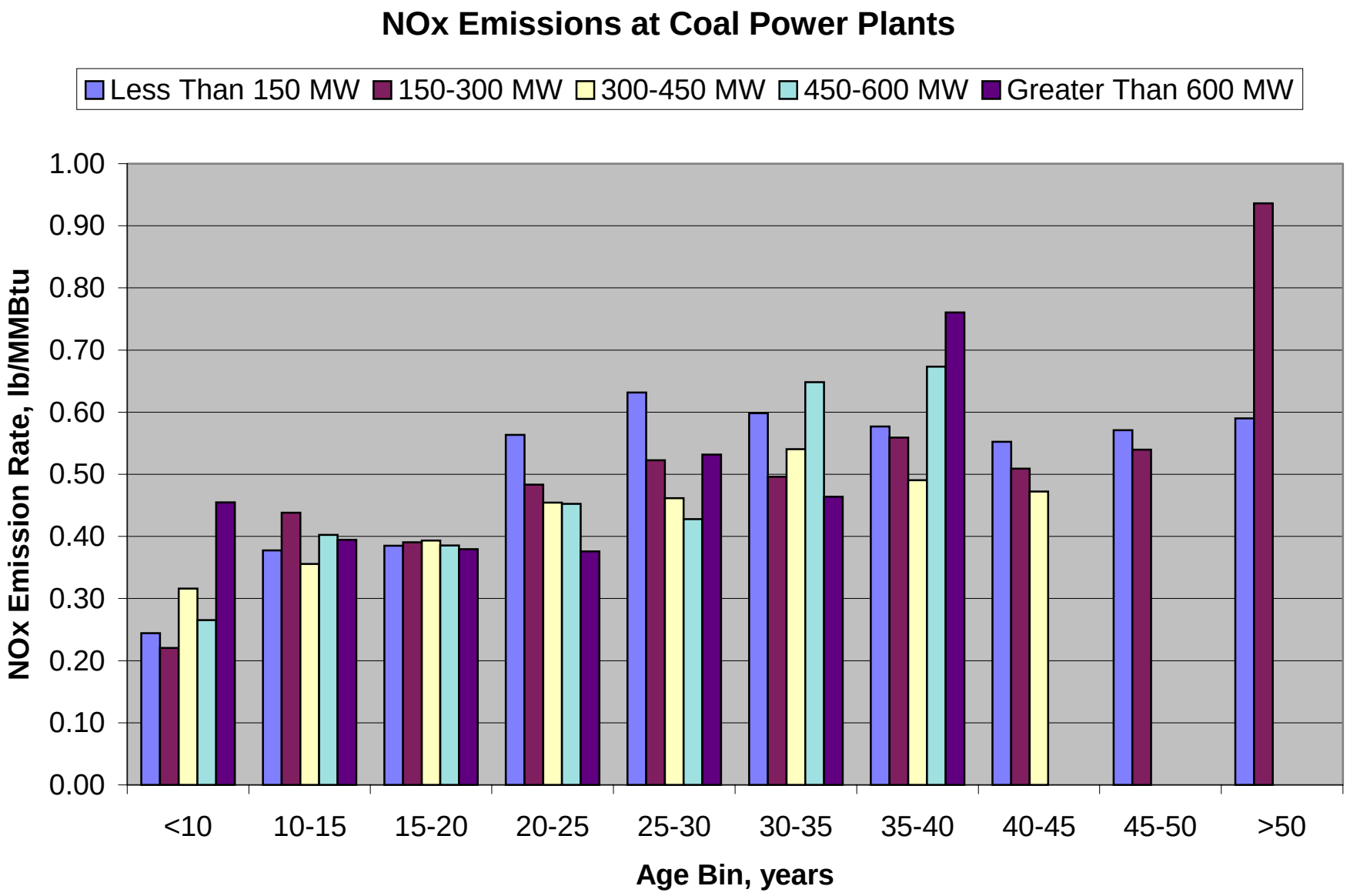
Average Boiler Size Distribution

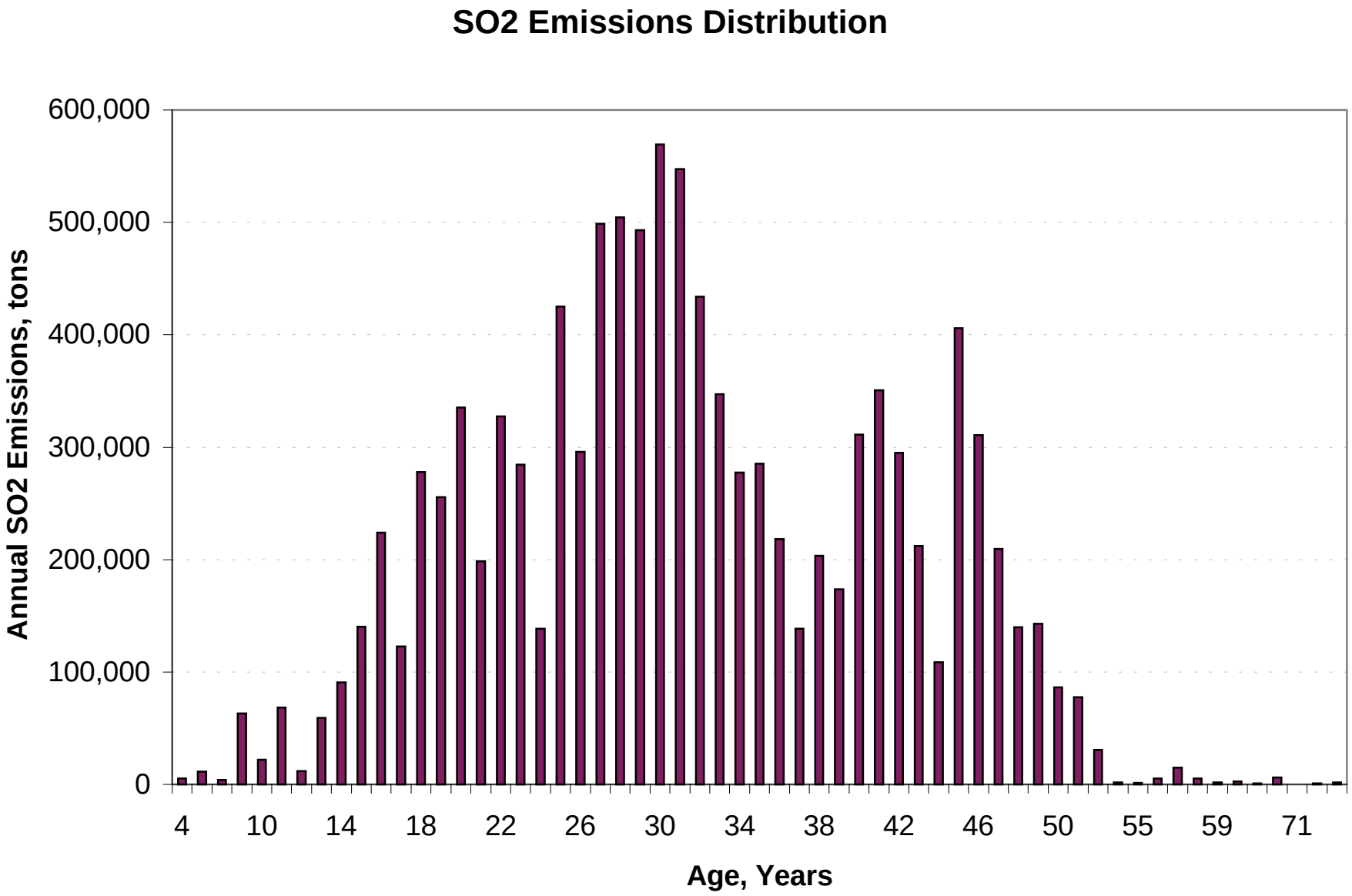


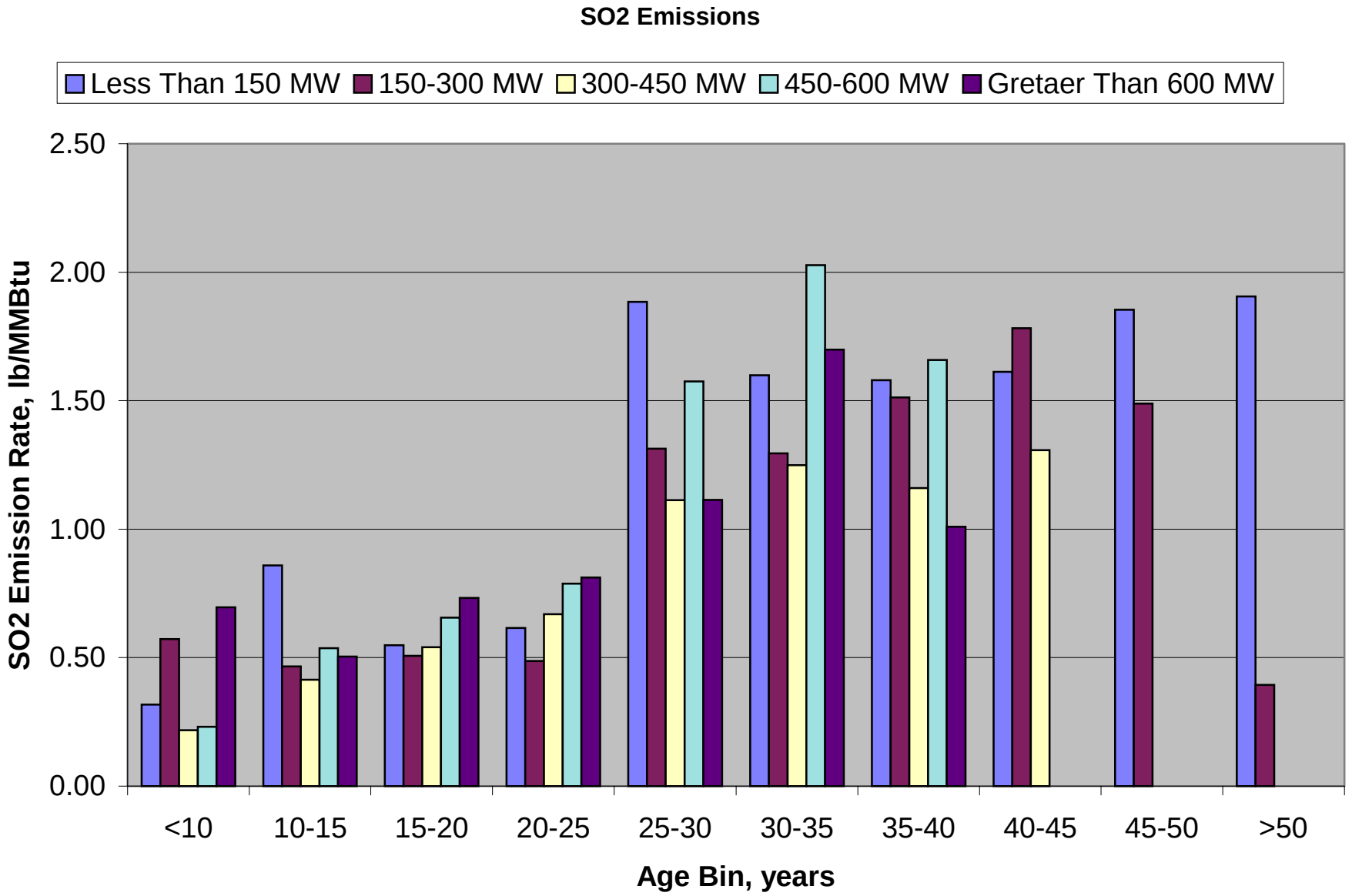

Age and Size Distribution
Less Than 150 MW
150-300 MW
300-450 MW
450-600 MW
Greater Than 600 MW
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Capacity Within Bin, MW
<10
10-15
15-20
20-25
25-30
30-35
35-40
40-45
45-50
>50
Age Bin, years

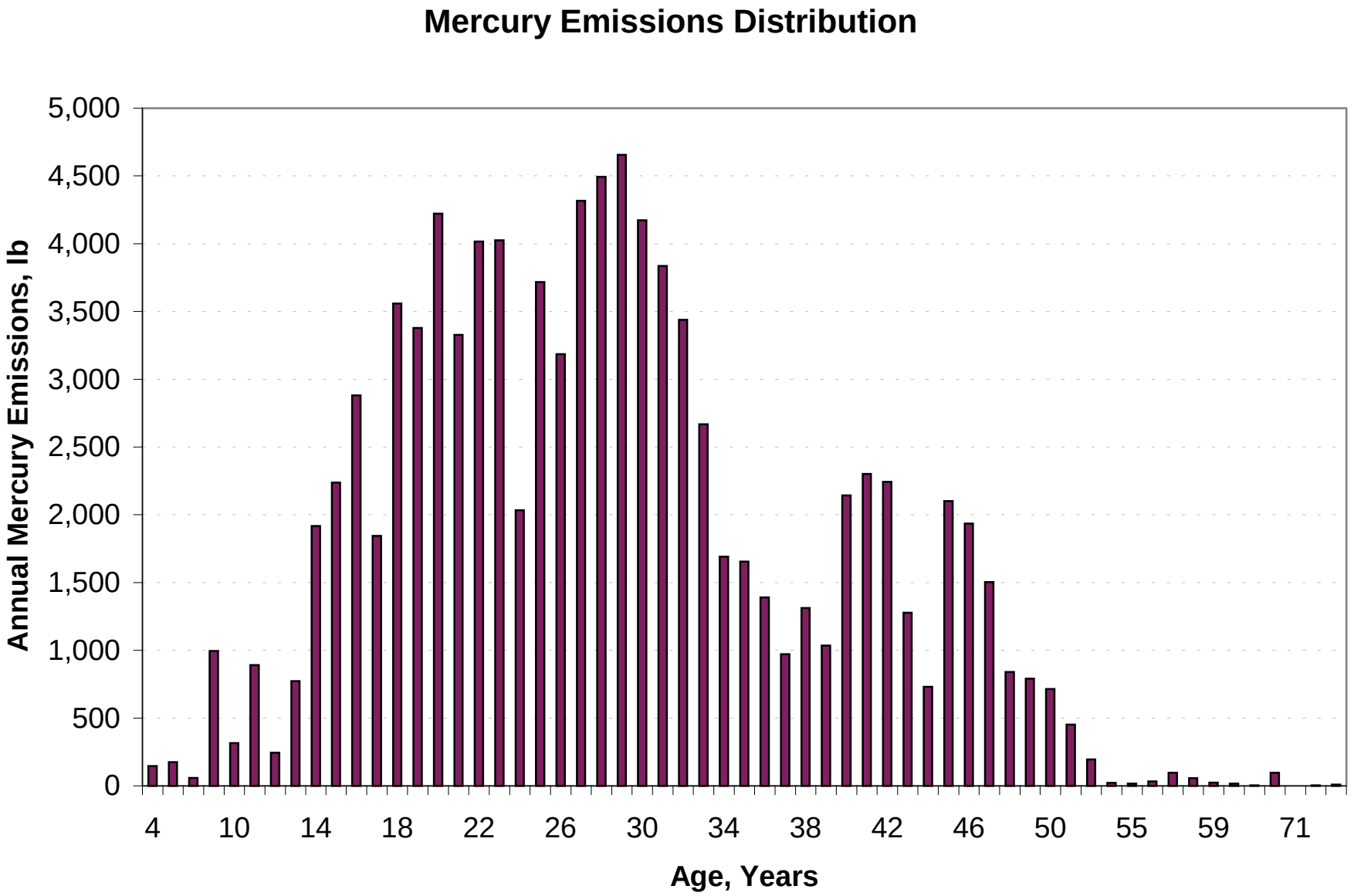

Age and Size Distribution
Less Than 150 MW
150-300 MW
300-450 MW
450-600 MW
Greater Than 600 MW
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Capacity Within Bin, MW
<10
10-15
15-20
20-25
25-30
30-35
35-40
40-45
45-50
>50
Age Bin, years

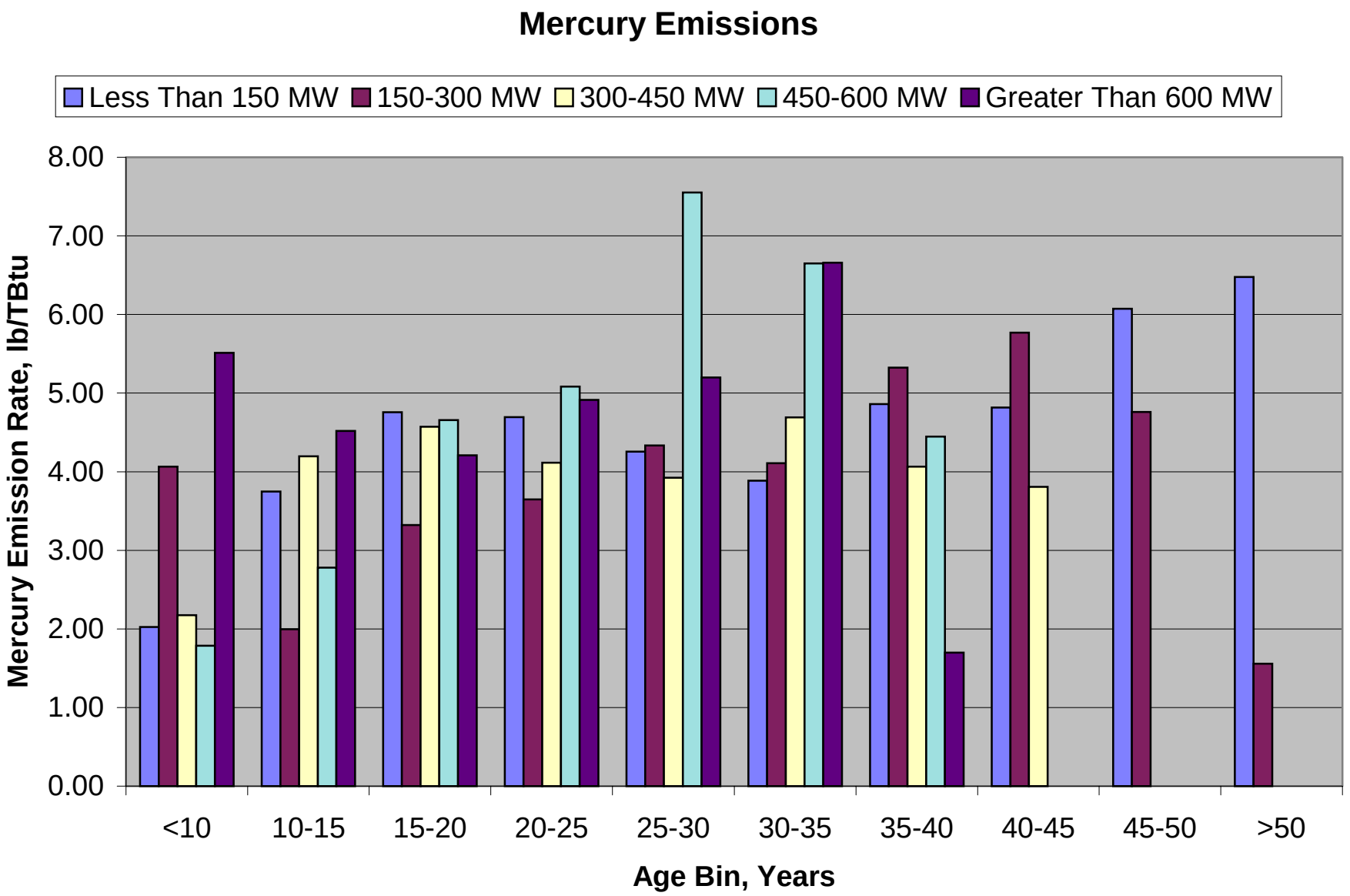

NOx Emissions Distribution
Annual NOx Emissions, tons
300,000
250,000
200,000
150,000
100,000
50,000
0
4
10
14
18
22
26
30
34
38
42
46
50
55
59
71
Age, Years


NOx Emissions at Coal Power Plants
Less Than 150 MW
150-300 MW
300-450 MW
450-600 MW
Greater Than 600 MW
NOx Emission Rate, lb/MMBtu
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
<10
10-15
15-20
20-25
25-30
30-35
35-40
40-45
45-50
>50
Age Bin, years


SO2 Emissions Distribution
Annual SO2 Emissions, tons
600,000
500,000
400,000
300,000
200,000
100,000
0
4
10
14
18
22
26
30
34
38
42
46
50
55
59
71
Age, Years


SO2 Emissions
Less Than 150 MW
150-300 MW
300-450 MW
450-600 MW
Gretaer Than 600 MW
SO2 Emission Rate, lb/MMBtu
2.50
2.00
1.50
1.00
0.50
0.00
<10
10-15
15-20
20-25
25-30
30-35
35-40
40-45
45-50
>50
Age Bin, years


Mercury Emissions Distribution
Annual Mercury Emissions, lb
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
4
10
14
18
22
26
30
34
38
42
46
50
55
59
71
Age, Years


Mercury Emissions
Less Than 150 MW
150-300 MW
300-450 MW
450-600 MW
Greater Than 600 MW
Mercury Emission Rate, lb/TBtu
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
<10
10-15
15-20
20-25
25-30
30-35
35-40
40-45
45-50
>50
Age Bin, Years